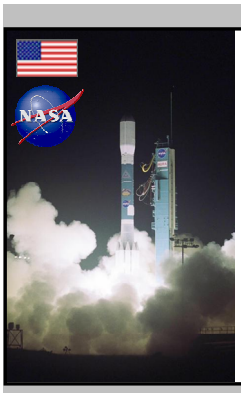


Abstract

With many papers published in the recent Journal of Geophysical Research "Special Collection on the Validation of NASA EOS-Aura", many excellent validation results are being reported that prove the Ozone Monitoring Instrument (OMI) satellite data to overall be of very high quality.

However, most validation studies have identified remaining algorithmic and validation issues that require new validation efforts. Here we present the validation priorities for the OMI instrument.

OMI Validation Priorities and Future Needs

Mark Kroon, Pepijn Veefkind and Pieternel Levelt – KNMI

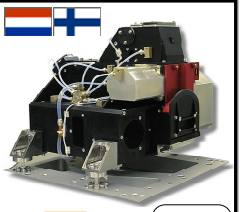
Richard McPeters and P.K. Bhartia - GSFC

Aura Science Team Meeting
Sheraton Columbia Hotel
Columbia, MD. 26 October 2008

Abstract

In summary, the order of validation priorities is; (1) nitrogen dioxide, (2) ozone, (3) aerosols, (4) clouds, (5) other OMI species.

This order is based on; the current availability of collocated correlative data, the status of ground-based instruments, the maturity of retrieval algorithms for both ground-based and satellite based observations, and the influence of clouds and aerosols on trace gas retrievals.



O3 NO2 SO2
OClO BrO
HCHO clouds
aerosols
surface-UV

Nitrogen Dioxide (1)

Retrieval Challenges

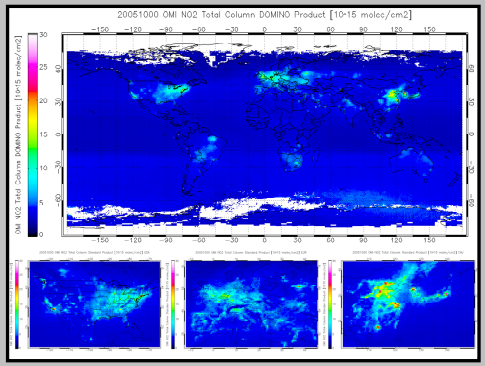
- Most retrievals calculate same Slant Column Density
- Air Mass Factor calculation differs by research group
- Different versions of column NO2 and trop. NO2 (level 1B publ.)

Need for validating retrieval input and satellite output data

- NO2 profiles in polluted regions, NO2 diurnal cycle, emissions
- Cloud fraction and cloud height (related issue)
- Total / tropospheric NO2 columns in polluted regions

Campaigns versus Networks

- INTEX-B and DANDELIONS-1 and 2 have proven relevance
- Much effort and cost yielding sparse and compact data sets
- Need for network in polluted regions providing continuity



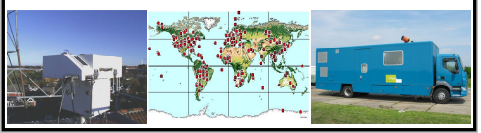
Nitrogen Dioxide (2)

Ground Truth

- Molybdenum systems measure more than NO2
- Most NO2 specific systems are "research grade"
- DOAS systems sparse, no network, research level
- NO2 lidar systems are expensive

An "Aeronet"-like network for NO2 IS DESIRED

- Reference network of observations providing continuity
- Central archive, common retrieval, reprocessing
- Pandora, direct sun, (mini)MAX-DOAS, Double Brewer

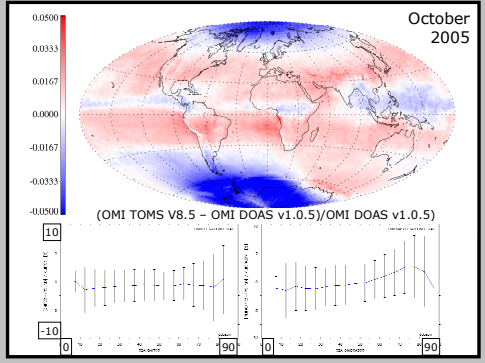


Total Ozone Column

- OMI retrievals at high SZA remain challenging (e.g. OMI-DOAS)
- Single Brewer systems have problems at high SZA low S/N
- SAUNA-I and SAUNA-II may provide answers
- If not sufficient a SAUNA –III is needed

SAUNA
Sodankyla Total Column Ozone Intercomparison

- Cloud height influence identified (climatology vs O2-O2)
- Need for further analysis TC-4 data (lidar, CAFS, T)
- UAV 2009 campaign should focus on remaining needs



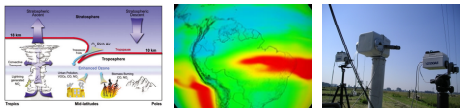
Tropospheric Ozone Column

Strong interest from Air Quality perspective

- Air pollution constituent, respiratory illnesses
- Obtained from OMI-MLS and other techniques (e.g. Schoeberl)
- ~10% of total column, 1%*300DU=3DU=10% of trop

Campaigns versus Networks

- Aircraft in-situ/remote sensing in polluted regions
- (tethered) Balloons and Ozone lidars in polluted regions
- Ground truth with (mini) MAX-DOAS



Aerosols

Retrieval Issues

- Retrievals use auxiliary data (surface albedo, aerosol microphysical properties, wind speed, etc.)
- Retrievals themselves are accurate (χ^2), outcome does not correlate well with Aeronet or Sat-Sat (MODIS, PARASOL)

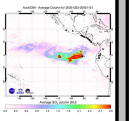
Validation of auxiliary data

- Aerosol microphysical properties, global distributions of aerosols (e.g. type), layer altitudes, transport
- Airborne campaigns flying PALMS-like systems (e.g. type)

Sulphur Dioxide (SO2)

Retrieval issues

- Depends on height of layer, profile and aerosols
- Depends on abundance which approach to take



In situ SO2 observations from aircraft

- near volcanoes for plume characterization
- areas of high SO2 pollution (China, East Europe)
- Importance of aircraft profiling of SO2 in PBL
- simultaneous measurements of aerosol type (dust vs sulfate or soot) and SO2 profiles.

Ground based column SO2 measurements

- double Brewer instruments (not single Brewers)
- (MAX)-DOAS type systems
- need for advanced Brewer SO2 algorithm

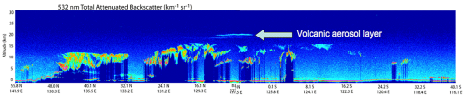
Clouds

Clouds and Retrievals

- Cloud height (UV-VIS-IR) and Cloud fraction (model dep.)
- Both influence trace gas retrievals, particularly tropospheric column estimates but also total ozone column (e.g. OMI-TOMS)

Validation

- Sat-Sat is key (e.g. MODIS, Parasol, CloudSat, Calipso)
- TC-4 data will help to validate / evaluate OMI data
- Ground radar/lidar for PBL and cloud height



OMI Validation Priorities

Nitrogen Dioxide (NO2)
Air pollution constituent, antropogenic proxy, emission estimates
Sparse correlative data, many retrieval challenges

Ozone (O3)
Air pollution constituent, health hazard, ozone (hole) recovery
Remaining retrieval challenges (tot-O3C, trop-O3C)

Aerosols
Air pollution constituent, retrieval challenges, physics of aerosols

Sulphur Dioxide (SO2)
Air pollution constituent, emission estimates, aviation warning

Clouds
Influence to (tropospheric) trace gas retrievals

"Minor" trace gases (BrO, OClO, HCHO, CHO-CHO)
Shortage of correlative data in general

OMI Validation Needs

Ground-based instruments

a. MAXDOAS network; NO2, SO2, HCHO, BrO, O3, aerosols [col,prof]
b. Double monochromator Brewer: O3, NO2, SO2 [col]
c. Network of PANDORA direct-sun: NO2 and SO2 [col]
d. Ozonesondes, O3, H2O [prof]

Aircraft remote sensing instruments

a. nadir-viewing DOAS instrument: NO2, O3, SO2 [trop_col]
b. CAFS and ACAM: O3, NO2 [trop_col, strat_c]
c. Airborne MAXDOAS instrument [tot & trop, col & prof]
d. Tropospheric NO2 lidar [trop_prof]

Aircraft in-situ instruments

a. NO2 specific in-situ
b. Aerosol optical absorption and scattering properties
c. Aerosol chemical composition and particle size distribution
d. SO2 in-situ

GEOMON 2009 Announcement

Cabauw, The Netherlands, June-July 2009

KNMI	NL	OMI, SCIAMACHY, Mini MAXDOAS
RIVM	NL	NO2 lidar, backscatter lidar, NO2 in situ
BIRA-IASB	BE	MAXDOAS, Mini MAXDOAS
IUP Heidelberg	DE	MAXDOAS
IUP Bremen	DE	MAXDOAS
Max-Planck	DE	Mini MAXDOAS
NASA	USA	PANDORA
WSU	USA	MFDOAS
UC Boulder	USA	MAXDOAS
EMPA	CH	NO2 in situ Blue Light Converter
CNRS	FR	SAOZ
JAMSTEC	JP	MAXDOAS
NIWA	NZ	MAXDOAS
Univ. Leicester	UK	CMDOAS
NIRC	UK	MAXDOAS
INTA	ES	MAXDOAS
Univ. Toronto	CA	UVVIS spectrometer

The Dutch-Finnish built OMI instrument is part of the NASA EOS Aura satellite payload. The OMI project is managed by NIVR and KNMI in The Netherlands. OMI level2 data is publically available from the NASA DISC system (http://disc.gsfc.nasa.gov). Please consult the README file of the data products of interest. OMI NO2 NRT data are obtained from the KNMI TEMIS website (http://www.temis.nl). Please visit us at http://www.knmi.nl /omi.